**The status of herbicide resistance in China: a** **quantitative review**

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**Supplementary Materials**

**Table S1 Resistant weeds in Chinese rice fields**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **#** | **Weed species** | **HRAC\* classification (herbicide)** | **Reference** | **Cross-resistance** | **Mutiple resistance** |
|  | [*Echinochloa crus-galli*](http://frps.eflora.cn/frps/Echinochloa%20crusgalli) | Long chain fatty acid inhibitors (butachlor, pretilachlor);  Lipid inhibitors (thiobencarb, molinate);  Synthetic auxins (quinclorac);  ALS inhibitors (penoxsulam,pyribenzoxim,pyrazosulfuron-ethyl, bispyribac-sodium);  ACCase inhibitors (fenoxaprop-P-ethyl, metamifop, cyhalofop-butyl);  PPO inhibitors (oxadiazon, oxyfluorfen);  Microtubule inhibitors (pendimethalin) | [Chen et al.,2016](#_ENREF_16);苏少泉,2001 | **yes** | **yes** |
|  | *Echinochloa glabrescens* | Long chain fatty acid inhibitors (butachlor);  PPO inhibitors (oxadiazon) | 王琼et al,2015 |  |  |
|  | *E. crus-galli var. mitis* | Long chain fatty acid inhibitors (butachlor);  Synthetic auxins (qu iclorac);  PPO inhibitors (oxadiazon) | 王琼et al,2015 |  |  |
|  | [*Echinochloa oryzoides*](http://foc.eflora.cn/search.aspx?id=1&k=Echinochloa%20oryzoides) | ALS inhibitors (penoxsulam and bensulfuron-methy) ;  Long chain fatty acid inhibitors (butachlor) ;  Synthetic auxins (qauinclorac); | 李俭et al,2015;冯雷,2018 |  |  |
|  | *E. crus-galli var. zelayensis* | Synthetic auxins (quinclorac);  Long chain fatty acid inhibitors (butachlor) | 徐江艳,2013;余艳芳,2013 |  |  |
|  | [*Echinochloa caudata*](http://frps.eflora.cn/frps/Echinochloa%20caudata) | Synthetic auxins (quinclorac) | 蒋爱丽et al.,2005 |  |  |
|  | *Echinochloa colonum* | Long chain fatty acid inhibitors (butachlor);  Synthetic auxins (quinclorac);  ACCase inhibitors (cyhalofop-butyl) | 余艳芳,2013 |  |  |
|  | *Leptochloa chinensis* | ACCase inhibitors (cyhalofop-butyl, fenoxaprop-P-ethyl) | [Yu et al.,2017](#_ENREF_144);陈轶,2014 |  |  |
|  | *Leersia hexandra* | ALS inhibitors (penoxsulam,bensulfuron-methy);  Synthetic auxins (qauinclorac);  ACCase inhibitors (cyhalofop-butyl) | 李俭et al.,2015;单国侠，2015;杨德亮,2014 |  |  |
|  | *Sagittaria trifolia var. sinensis* | ALS inhibitors (bensulfuron-methyl,pyrazosulfuron-ethyl, penoxsulam);  Long chain fatty acid inhibitors (butachlor);  PPO inhibitors (oxadiazon) | 吴明根et al.,2007;单国侠，2015;徐凤et al.,2013 | **yes** |  |
|  | *S. trifolia* | ALS inhibitors (bensulfuron-methyl , pyrazosulfuron-ethyl and ethoxysulfuron, bispyribac-sodium, pyrazosulfuron-ethyl) | [Fu et al.,2017](#_ENREF_44);李平生et al.,2015 | **yes** |  |
|  | *Sagittaria montevidensis* | ALS inhibitors (bensulfuron-methyl) | 陈轶,2014 |  |  |
|  | *Sagittaria sagittifolia* | ALS inhibitors (bensulfuron-methyl) | 李昕珈et al.,2010 |  |  |
|  | *Cyperus difformis* | ALS inhibitors (halosulfuron-methyl, pyrazosulfuron－ethyl, penoxsulam) | 高陆思et al.,2015 | **yes** |  |
|  | *Scirpus triqueter* | ALS inhibitors (bensulfuron-methyl) | 李昕珈et al.,2010 |  |  |
|  | *Scirpus planiculmis* | ALS inhibitors (bensulfuron-methyl, pyrazosulfuron-ethyl) | 吴明根et al.,2007 |  |  |
|  | *Heleocharis yokoscensis* | ALS inhibitors (bensulfuron-methy) | 李昕珈et al.,2010 |  |  |
|  | *Schoenoplectus juncoides* | ALS inhibitors (bensulfuron-methyl,pyrazosulfuron-ethyl);  Long chain fatty acid inhibitors (butachlor) | 李威,2014;徐凤et al.,2013 |  |  |
|  | *Monochoria vaginalis* | ALS inhibitors (bensulfuron-methyl) | 陈轶,2014 |  |  |
|  | *Monochoria korsakowii* | ALS inhibitors (bensulfon-methyl ,pyraosulfuron-ethyl, penoxsulam) | [Lu et al.,2009](#_ENREF_85);单国侠，2015;吴明根et al.,2007 | **yes** |  |
|  | *Digitaria sanguinalis* | ALS inhibitors (penoxsulam);  ACCase inhibitors (metamifop) | 蒋易凡et al.,2017 |  |  |
|  | *Ammannia arenaria* | ALS inhibitors (bensulfuron-methyl, penoxsulam, bispyribac-sodium) | 王兴国et al.,2013;朱金文et al.,2015 | **yes** |  |
|  | *Ammannia multiflora* | PSII inhibitors (nitriles) (bentazone);  Synthetic auxins (MCPA) | 陈轶,2014 |  |  |
|  | *Rotala indica* | ALS inhibitors (bensulfuron-methyl ) | 金圣务,2012 |  |  |
|  | *Potamogeton distinctus* | ALS inhibitors (bensulfuron methyl, pyrazosulfuron-ethyl) | 叶照春et al.,2013 | **yes** |  |
|  | *Eclipta prostrata* | ALS inhibitors (pyrazosulfuron-ethyl) | 李丹et al.,2017 |  |  |

**“\*”:** Herbicide Resistance Action Committee

**Table S2 Resistant weeds in Chinese wheat fields**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **#** | **Weed species** | **HRAC\* classification (herbicide)** | **Reference** | **Cross-resistance** | **Mutiple resistance** |
|  | *Alopecurus japonicus* | ACCase inhibitors (fenoxaprop-p-ethyl, clodinafop-propargyl, pinoxaden, clethodim, haloxyfop-P-methyl);  ALS inhibitors (mesosulfuron-methyl, rimsulfuron, nicosulfuron, sulfosulfuron, imazapic, penoxsulam, pyribenzoxim, pyroxsulam, flucarbazone-sodium);  PSII inhibitors (ureas and amides) (isoproturon)  PSII inhibitors (prometryn) | [Chen et al.,2017a](#_ENREF_15);[Cui et al.,2015](#_ENREF_25);[Bi et al.,2016a](#_ENREF_9);[Feng et al.,2016](#_ENREF_42) | **yes** | **yes** |
|  | *Alopecurus aequalis* | ACCase inhibitors (fenoxaprop-P-ethyl, pinoxaden, clodinafop-propargyl , sethoxydim,haloxyfop, clethodim, pinoxaden);  ALS inhibitors (mesosulfuron-methyl, pyroxsulam, flucarbazone-Na) | [Guo et al.,2015a](#_ENREF_52);[Guo et al.,2015b](#_ENREF_54);[Guo et al.,2016](#_ENREF_55) | **yes** |  |
|  | *Bromus japonicus* | ALS inhibitors (pyroxulam) | 袁立兵et al.,2013 |  |  |
|  | *Bromus tectorum* | ACCase inhibitors (haloxyfop-P-methyl) | 吕晓辉et al.,2016a |  |  |
|  | *Avena fatua* | ACCase inhibitors (haloxyfop-P-methyl, clodinafop-propargy, fenoxaprop-P-ethyl) | 吕晓辉et al.,2016b;李鹏et al.,2017 |  |  |
|  | *Beckmannia syzigachne* | ACCase inhibitors (fenoxaprop-P-ethyl, fenoxaprop-P-ethyl, clodinafop-propargyl, fluazifop-P-butyl, haloxyfop-P-methyl, sethoxydim, clethodim and pinoxaden, quizalofop-P-ethyl, cyhalofop-butyl, metamifop);  ALS inhibitors (mesosulfuron-methyl, pyroxsulam, flucarbazone-sodium);  PSII inhibitors (ureas and amides) (isoproturon) | [Du et al.,2016b](#_ENREF_39);[Pan et al.,2015](#_ENREF_100);[Li et al.,2017c](#_ENREF_80);[Li et al.,2015](#_ENREF_79);陈轶,2014 | **yes** | **yes** |
|  | *Aegilops tauschii* | ALS inhibitors (mesosulfuron-methyl) | 隋标峰et al.,2009 |  |  |
|  | *Pseudosclerochloa kengiana* | ACCase inhibitors (fenoxaprop-P-ethyl, clodinafop-propargyl, sethoxydim, and pinoxaden  fluazifop-P-butyl , diclofop) | [Yuan et al.,2015](#_ENREF_148);[Yuan et al.,2017](#_ENREF_149) |  |  |
|  | *Polypogon fugax* | ACCase inhibitors (clodinafop-propargyl) | [Tang et al.,2014](#_ENREF_123);[Zhou et al.,2017](#_ENREF_159) |  |  |
|  | *Lolium perenne* | ACCase inhibitors (fenoxaprop-P-ethyl, haloxyfop-R-methyl, quizalofop-P-ethyl, clodinafop-propargyl, clethodim,pinoxaden) | [Zhang et al.,2017c](#_ENREF_153) |  |  |
|  | *Descurainia sophia* | ALS inhibitors (tribenuron-methyl, halosulfuron-methyl, flumetsulam, imazethapyr, pyribenzoxim, flucarbazone-Na, triasulfuron, penoxsulam, bispyribac-sodium, cloransulam-methyl, pyroxsulam, florasulam, bensulfuron-methy);  Synthetic auxins (MCPA-Na, 2,4-D butylate);  PPO inhibitors (carfentrazone-ethyl) | [Cui et al.,2009](#_ENREF_27);[Deng et al.,2017](#_ENREF_36);[Deng et al.,2014](#_ENREF_33);崔海兰,2009;王伟,2015;彭学岗,2012 | **yes** |  |
|  | *Myosoton aquaticum* | ALS inhibitors (tribenuron-methyl ,pyrithiobac-sodium, florasulam, pyroxsulam, flucarbazone-sodium) | [Liu et al.,2013a](#_ENREF_81);[Liu et al.,2013b](#_ENREF_82);[Liu et al.,2015b](#_ENREF_84) | **yes** |  |
|  | *Stellaria media* | PSII inhibitors (ureas and amides) (isoproturon);  Synthetic auxins (fluroxypyr, MCPA-Na) | 陈轶,2014;彭学岗,2012 |  |  |
|  | *Galium aparine* | ALS inhibitors (tribenuron-methyl, bensulfuron-methy);  PSII inhibitors (ureas and amides)(Isoproturon);  Synthetic auxins (fluroxypyr, MCPA-Na) | [Sun et al.,2011](#_ENREF_120);陈轶,2014;王红春 et al.,2017 |  |  |
|  | *Capsella bursa-pastoris* | ALS inhibitors (tribenuron-methyl, flucarbazone-Na, florasulam, pyrithiobac sodium, pyroxsulam, imazethapyr) | [Wang et al.,2011](#_ENREF_130);[Zhang et al.,2017b](#_ENREF_152);李健 et al.,2015 | yes |  |
|  | *Silene conoidea* | ALS inhibitors (tribenuron-methyl) | 刘伟，2005 |  |  |
|  | *Lithospermum arvense* | ALS inhibitors (tribenuron-methyl) | 吴小虎et al.,2011 |  |  |
|  | *Vicia sativa* | ALS inhibitors (tribenuron-methyl) | 张迪,2016 |  |  |

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**Table S3 Resistant weeds in other major cropping systems in China**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Crop** | **Weed species** | **HRAC\* classification (herbicide)** | **Reference** | **Cross-resistance** | **Mutiple resistance** |
| Corn | *Setaria viridis* | ALS inhibitors (nicosulfuron) | 吴翠霞 et al.,2016 |  |  |
| *Chloris virgata.* | ALS inhibitors (nicosulfuron) | 吴翠霞 et al.,2016 |  |  |
| *Eleusine indica* | ALS inhibitors (nicosulfuron);  Photosystem II inhibitors (atrazine ) | 吴翠霞 et al.,2016 |  |  |
| *Echinochloa crus-galli* | ALS inhibitors (nicosulfuron);  Photosystem II inhibitors (atrazine ) | 吴翠霞 et al.,2016  潘思杨,2015 |  |  |
| *Digitaria sanguinalis* | ALS inhibitors (nicosulfuron);  Photosystem II inhibitors (atrazine ) | [Mei et al.,2017](#_ENREF_88);周青 et al.,2005;张宏军 et al.,2013 |  |  |
| *Amaranthus retroflexus* | ALS inhibitors (thifensulfuron-methyl);  Photosystem II inhibitors (atrazine);  ALS inhibitors (nicosulfuron) | 井秋月 et al.,2014;孙会杰 et al.,2007;袁雪 et al.,2017;葛鲁安et al., 2018 |  |  |
| *Equisetum arvense* | ALS inhibitors (nicosulfuron);  Photosystem II inhibitors (atrazine ) | 潘思杨,2015 |  |  |
| *Eriochloa villosa* | ALS inhibitors (nicosulfuron) | 马红 et al, 2018 |  |  |
| *Cucumis melo var. agrestis* | ALS inhibitors (nicosulfuron, imazapic);  PPO inhibitors (fomesafen) | Xu et al., 2018 |  |  |
| Soybean | *D. sanguinalis* | ACCase inhibitors (haloxyfop-P-methyl quizalofop-P-ethyl, sethoxydim) | 张陈川,曾爱平,2015;滕芳超,王金信,2014 |  |  |
| *E. crus-galli* | ACCase inhibitors (quizalofop-P-ethyl ) | 郇志博,2011 |  |  |
| *E. crus-galli var. mitis* | ACCase inhibitors (quizalofop-P-ethyl ) | 郇志博,王金信,2013 |  |  |
| *Commelina communis* | Microtubule inhibitors (trifluralin);  PPO inhibitors (fomesafen) | 张浩 et al.,2000;贾伟,董庆文,2015 |  |  |
| *Bidens tripartita* | Microtubule inhibitors (trifluralin) | 张浩 et al.,2000 |  |  |
| *Xanthium sibiricum* | Microtubule inhibitors (trifluralin) | 张浩 et al.,2000 |  |  |
| *Polygonum lapathifolium* | Microtubule inhibitors (trifluralin) | 张浩 et al.,2000 |  |  |
| *Solanum nigrum* | Microtubule inhibitors (trifluralin) | 张浩 et al.,2000 |  |  |
| *S. media* | Microtubule inhibitors (trifluralin) | 张浩 et al.,2000 |  |  |
| *A. retroflexus* | ALS inhibitors (thifensulfuron-methyl, pyrithiobac-sodium, pyroxsulam, imazethapyr) ;  PPO inhibitors (fluoroglycofen,fomesafen ) | [Wang et al.,2017](#_ENREF_132) |  |  |
| *C. melo var. agrestis* | ALS inhibitors (nicosulfuron, imazapic);  PPO inhibitors (fomesafen) | Xu et al., 2018 |  |  |
| Rapeseed | *Alopecurus japonicus* | ACCase inhibitors (haloxyfop-R-methyl, quizalofop-P-ethyl, fenoxaprop-P-ethyl, clodinafop-propargyl, cyhalofop-butyl) | [Tang et al.,2012](#_ENREF_122) | **yes** |  |
| *Alopecurus aequalis* | ACCase inhibitors (quizalofop-P-ethyl, clethodim, haloxyfop-P-methyl, quizalofop-P-ethyl, sethoxydim) | 唐子慧,周小毛,2016;黄世霞,2004, | **yes** |  |
| *Avena fatua* | ACCase inhibitors (haloxyfop-P-methyl) | 吕晓辉 et al.,2016b |  |  |
| *Bromus tectorum* | ACCase inhibitors (haloxyfop-P-methyl) | 吕晓辉 et al.,2016a |  |  |
| *Polypogon fugax* | ACCase inhibitors (clodinafop-propargyl, fenoxaprop-P-ethyl, quizalofop-P-ethyl, haloxyfop-R-methyl, fluazifop-p-butyl) | [Tang et al.,2014](#_ENREF_123) | **yes** |  |
| Cotton | *Eleusine indica* | EPSP synthase inhibitors (glyphosate);  ACCase inhibitors (haloxyfop-P-methyl,quizalofop-P-ethyl) | 王新玲 et al.,2016;李洁 et al.,2014;宗涛 et al.,2015 |  |  |
| *D. sanguinalis* | EPSP synthase inhibitors (glyphosate) | 李玉,柏连阳,2016 |  |  |
| *Leptochloa chinensis* | ACCase inhibitors (haloxyfop-P-methyl);  EPSP synthase inhibitors (glyphosate) | 唐鑫 et al.,2016 |  |  |
| *Amaranthus retroflexus* | EPSP synthase inhibitors (glyphosate) | 杨浩娜,柏连阳,2016 |  |  |
| *Portulaca oleracea L.* | EPSP synthase inhibitors (glyphosate) | 杨浩娜,柏连阳,2016 |  |  |
| Orchard | *E. indica* | PSI Electron Diverter (paraquat);  EPSP synthase inhibitors (glyphosate);  ALS inhibitors (bispyribac-sodium);  Glutamine synthase inhibitors (glufosinate-ammonium) | [An et al.,2014](#_ENREF_1);[Zhang et al.,2015](#_ENREF_150);  姚和金 et al.,2008胡芳et al., 2018 |  |  |
| *Erigeron canadensis* | PSI Electron Diverter (paraquat);  EPSP synthase inhibitors (glyphosate) | 李晓霞 et al.,2015;梅宇 et al.,2015 |  |  |
| *Acalypha australis* | ALS inhibitors (bispyribac-sodium);  EPSP synthase inhibitors (glyphosate) | 姚和金 et al.,2008 |  |  |
| *Conyza canadensis* | EPSP synthase inhibitors (glyphosate) | Mei et al., 2018 |  |  |
| peanut | *D. sanguinalis* | ACCase (quizalofop-P-ethyl, sethoxydim) | 李浙江，2006 |  |  |
| *E. indica* | ACCase (quizalofop-P-ethyl, sethoxydim) | 李浙江，2006 |  |  |
| *C. melo var. agrestis* | ALS inhibitors (nicosulfuron, imazapic);  PPO inhibitors (fomesafen) | Xu et al., 2018 |  |  |
| Sugarcane | *D. Sanguinalis* | Photosystem II inhibitors (atrazine ) | 王彦辉 et al.,2017 |  |  |
| Ramie | *Conyza canadensis* | EPSP synthase inhibitors (glyphosate) | 唐吉和and 戴良英,2011 |  |  |

**“\*”:** Herbicide Resistance Action Committee

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